Consolidated Water Use Efficiency 2002 PSP
Proposal Part One:

A. Project Information Form

1. Applying for:	☐ (a)Prop 13 Urban Water Conservation Capital Outlay Grant ☒ **(b) Prop 13 Agricultural Water Conservation Capital Outlay Feasibility Study Grant** ☐ (c) DWR Water Use Efficiency Project
2. Principal applicant (Organization or affiliation)	**California Polytechnic State University Foundation Irrigation Training and Research Center**
3. Project Title:	**Flow rate measurement instrumentation at ITRC to partially address all of the CALFED Quantifiable Objectives**
4. Person authorized to sign and submit proposal	**Jill Keezer, Director** **Sponsored Programs** **Cal Poly State University** **1 Grand Avenue** **San Luis Obispo, CA 93407** **Telephone: (805) 756-5729** **Fax: (805) 756-5588** **E-mail: jkeezer@calpoly.edu**
5. Contact Person:	**Stuart Styles - BRAE/ITRC** **Cal Poly State University** **1 Grand Avenue** **San Luis Obispo, CA 93407** **Telephone: (805)756-2429 (direct)** **(805)756-2434 (office)** **Fax: (805)756-2433** **E-mail: sstyles@calpoly.edu**
6. Funds requested:	**$89,000**
7. Applicant funds pledged:	**$257,000**
8. Total project costs:	**$346,000**

9. Estimated total quantifiable project benefits: **$N/A**
Training and Education project benefits cannot be quantified

Percentage of benefit to be accrued by applicant: **N/A**

Percentage of benefit to be accrued by CALFED or others: **N/A**

10. Estimated annual amount of water to be saved (acre-feet): **N/A**

Estimated total amount of water to be saved (acre-feet): **N/A**

Over ____ years

Estimated benefits to be realized in terms of water quality, instream flow, other: **N/A**

11. Duration of project: **Oct. 1, 2002 to June 30, 2004**

12. State Assembly District where the project is to be conducted: **Affects all irrigated portions of California**

13. State Senate District where the project is to be conducted: **Affects all irrigated portions of California**

14. Congressional district(s) where the project is to be conducted: **Affects all irrigated portions of California**

15. County where the project is to be conducted: **Affects all irrigated portions of California**

16. Date most recent Urban Water Management Plan submitted to the Department of Water Resources: **N/A**

17. Type of applicant:
Prop 13 Urban Grants and Prop 13 Agricultural Feasibility Study Grants:

- ☐ (a) city
- ☐ (b) county
- ☐ (c) city and county
- ☐ (d) joint power authority
- ☒ **(e) other political subdivision of the State including public water district**
- ☐ (f) incorporated mutual water company

DWR WUE Projects: the above entities (a) through (f) or:

- ☐ (g) investor-owned utility
- ☐ (h) non-profit organization
- ☐ (i) tribe
- ☐ (j) university
- ☐ (k) state agency
- ☐ (l) federal agency

18. Project focus:

- ☒ **(a) agricultural**
- ☐ (b) urban

19. Project type:
Prop 13 Urban Grants or Prop 13 Agricultural Feasibility Study Grant capital outlay project related to:

- ☐ (a) implemenation of Urban Best Management Practices
- ☒ **(b) implementation of Agricultural Efficient Water Managemet Practices**
- ☐ (c) implementation of Quanitifable Objectives (include QO number(s))
- ☐ (d) other (specify)

DWR WUE Project related to:

- ☐ (e) implementation of Urban Best Management Practices
- ☐ (f) implementation of Agricultural Efficient Water Management Practices
- ☐ (g) implementation of Quantifiable Objectives
- ☐ (h) innovative projects (initial investigation of new technologies, methodologies, approaches, or institutional frameworks)
- ☐ (i) research or pilot projects
- ☐ (j) education or public information programs
- ☐ (k) other (specify)

20. Do the actions in this proposal involve physical changes in land use, or potential future changes in land use?

- ☐ (a) yes
- ☒ **(b) no**

Consolidated Water Use Efficiency 2002 PSP
Proposal Part One:
B. Signature Page

By signing below, the official declares the following:

The truthfulness of all representations in the proposal;

The individual signing the form is authorized to submit the proposal on behalf of the applicant; and

The individual signing the form read and understood the conflict of interest and confidentiality section and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant.

_____ _____
Jill Keezer, Director Date
Sponsored Programs

_____ _____
Stuart Styles, Director Date
Cal Poly ITRC

Consolidated Water Use Efficiency 2002 PSP
Proposal Part Two

Project Summary

This is a proposal for a flow rate instrumentation project for the Cal Poly Irrigation Training and Research Center (ITRC). This proposal addresses "all" of the CALFED Quantifiable Objectives (QOs) by assisting irrigation districts with their implementation of QOs. The QO's depend on reliable and accurate flow rate measurement devices. Currently, the closest testing facilities for calibration is in Logan, Utah. Cal Poly ITRC is proposing a **$89,000** project to improve the existing teaching facilities. The project will help with the completion of a state-of-the-art water measurement weighing and volumetric tank. The new instrumentation will allow for NIST-traceable (National Institute of Standards and Technology) evaluation of new flow measurement technologies such as Doppler flow meters for turnouts.

A. Scope of Work: Relevance and Importance

1. Nature, Scope, and Objectives

The following is a brief summary of the facilities and the planned instrumentation improvements.

Water Delivery Facility

- *Components* - The Water Delivery Facility has a one acre reservoir, 11 pumps of various design powered by a 225Kva supply and an 80 HP natural gas engine. The pumps can be used to supply three canals; one 660 ft. with 6 pools with a maximum flow rate of 2000 GPM, and two 300 ft. canals each with a flow capacity from 3000 to 4000 GPM. Additional features of the facility include state-of-the-art SCADA (Supervisory Control and Data Acquisition) systems, modern RTUs (Remote Terminal Units) at 3 gates, redesigned gates on some structures, and a computer control system for this facility.

- *University Classes using facility* - BioResource and Agricultural Engineering (BRAE) 128, 216, 236, 324, 328, 340, 405, 414, 425, 438, 440, 492, 531, 533.

- *Size and scope of facilities* - Total area is approximately 5 plus acres, including a 2 acre pond with a storage capacity of 15 acre-feet.

- *Investment in fields/facilities to date* - Estimated cost $1,200,000. (Most of this facility has been developed with funds from non-university sources.)

- *Future needs for fields/facilities* - Indoor hydraulic testing facilities, hydraulic flume, weighing tank, and an outdoor irrigation equipment/system testing space. A California Energy Commission (CEC) grant for $512,585 was obtained in 2000 by ITRC to provide the support for new instrumentation for testing of new electronic flow measurement devices. Devices include new technologies such as the Doppler flow meter that is currently being evaluated by several irrigation districts. $200,000 of this grant was designated for new instrumentation. A California State University-Agriculture Research Initiative grant in the amount of $57,000 was obtained in 2000 for demonstration and testing facilities improvement. However, these grants did not cover all of the expenses for the new instrumentation. It is estimated that an additional **$89,000** is needed to complete new flow measurement instrumentation for a new weighing and volumetric tank.

In addition to being used by students at Cal Poly in regular classes, the Water Delivery Facility is also utilized for the irrigation classes for professionals. The following is a list of classes that will continue to use the new instrumentation components:

Water Delivery Modernization Training.
The successful "School of Irrigation for Irrigation Districts", has been held annually in the Fall at ITRC. This school provides two sets of classes; one for irrigation district operators, and

another for managers and engineers. The classes vary from 1-2 days in length each, and cover topics such as:

- Flow measurement in canals
- Flow measurement in pipelines
- General principles of modernization
- Advanced concepts in canal modernization
- SCADA systems
- Determining district water balances
- Hand Held Data Recorders

Water Conservation Coordinator Training

The Agricultural Water Management Council and USBR require a designated water conservation coordinator from each irrigation district as part of their water management plan. The ITRC has developed materials and curriculum to assist the water conservation coordinators in developing and implementing effective water management plans. This 1-2 day training will be updated annually and provided as part of the Irrigation District Training Classes.

On-Farm Irrigation Evaluation.

In the early 1980's, the ITRC developed, on behalf of the Water Conservation Office of the Calif. DWR, a 2.5 day class on Irrigation Evaluation techniques. That class has been offered twice per year since then with DWR funding. This class will continue to make a very important contribution to water conservation in California. It provides a standardized format for definitions of Irrigation Efficiency, and for the procedures to be used in measuring Irrigation Efficiency and Distribution Uniformity for on-farm irrigation. As a result of this standardized training, it is now much easier for persons to communicate regarding irrigation efficiency. Without continued training, there will be a wide mix of varying perceptions of what irrigation efficiency is, and how it can be measured. A clear perception is absolutely necessary if valid water conservation programs within districts are to be developed.

2. Statement of critical local, regional, Bay-Delta, State or federal water issues

Training of irrigation professionals will be a cornerstone of the implementation of the proposed CALFED QOs. This includes irrigation district personnel, irrigation engineers/planners, and regulatory personnel. The ITRC is uniquely qualified to provide the training. In addition, training of competent and qualified Cal Poly students will be essential for the future of irrigated agriculture.

It is also critical that California have access to a state-of-the-art testing instrumentation that could be used to rapidly and accurately verify flow rates through flow measurement devices. As CALFED is implemented, the new devices that are needed will need to be verified prior to use by irrigation districts.

B. Scope of Work: Technical/Scientific Merit, Feasibility, Monitoring and Assessment

1. Methods, procedures, and facilities.
Construction of the improvements will be done entirely by students and supervised by professional engineers. This is an action-specific proposal that allows for the improvement of training facilities at Cal Poly ITRC.

2. Task List and Schedule.
It is anticipated that the funds would be spent within one year with the majority of the funds (over 85%) being spent during the spring and summer of 2002.

Task 1 - Visit several commercial hydraulic labs to finalize instrumentation controls for new weighing and volumetric tank.

Task 2 - Design a monitoring and controls panel capable of providing rapid flow rate testing of devices.

Task 3 - Complete the new flume capable of carrying 25 cfs to the new tanks.

Task 4 - Add the components to simulate turnout conditions in the irrigation districts.

Task 5 - Incorporate a new flow conditioning test area to evaluate the effect of straightening flows in channels for better flow characteristics.

Task 6 - Provide documentation to NIST to become certified as an NIST-traceable flow rate system.

3. Monitoring and Assessment.
It is anticipated that the training program and the new facilities will help irrigation districts with their ultimate decrease in available water supplies. Since most irrigation district management has realized that they must modernize in order to help their farmers survive, these training classes will be essential to help districts deal with the changes.

4. Preliminary Plans and Specifications and Certification Statements.
See attached.

C. Qualifications of the Applicants and Cooperators

1. Resumes

The resume for Dr. Stuart Styles is attached. Others who will be participating in teaching classes include Dr. Charles Burt. Resumes for these individuals are also attached.

2. External Cooperators

There are no external cooperators scheduled for this program.

3. Partnerships

ITRC has been awarded a contract to perform Task 5 of the California Energy Commission project titled "Optimization of Water and Energy Resources Associated with Irrigation Water Delivery and Management". The funding for demonstration facilities would be folded into the CEC project by helping to fund some of the testing facilities required. The total contract amount for Task 5 of the CEC study is **$512,585**.

Task 5 deals with one of the most critical components of an irrigation project -- water measurement. The contract requires the use of facilities to test and monitor flow measurement equipment. Rather than contract with an out-of-state laboratory to perform the testing, ITRC would like to construct new instrumentation at the existing Water Deliver Facility located next to Drumm Reservoir. This area has been reserved by the Cal Poly Master Plan for ITRC expansion when the Bull Test Unit is moved.

Some specific challenges for flow rate management are:

- In the Sacramento Valley, many irrigation districts deliver water to farmers by gravity at high flow rates per turnout, at locations with almost no pressure loss available at the turnouts. Most of these turnout deliveries are not metered - the present flow metering technology is either too expensive or unsuitable for the conditions of high flow rates, very low pressure loss, and dirty water. Most of the canal water was originally pumped out of the Sacramento River even though the final deliveries are by gravity, which means that on-farm water measurement and management have a direct impact on pumping costs.

- Good flow rate and volumetric water measurement in drains and rivers is extremely sparse, partly because of the high expense of instrumenting such sites. Some of the new electronic technologies, coupled with flow conditioning, may have widespread applications here.

- Large measurement flumes for irrigation districts can cost $100,000 +, each. Perhaps some of the new technologies can perform the measurement for considerably less, with the same degree of accuracy.

Most agricultural irrigation districts are very interested in modernizing to support their farmer customers, as evidenced by strong ITRC activity with at least 20-30 irrigation districts per year. However, as noted above, significant technical issues remain, on which significant research is required, to improve the flexibility and reliability of water deliveries. Part of this research targets two aspects of energy conservation. First, it targets an improvement of energy efficiencies that are impacted by irrigation

today. Second, it targets future increases in energy consumption (due to groundwater pumping) by farmers who will turn to increased groundwater usage when to shift to more modern on-farm irrigation methods.

Magnetic and ultrasonic flow measurement technologies have been installed in a few irrigation districts over the past 5 years. However, these applications have all been on large pipelines or large canals. With a cost that varies from about $5,000 - $30,000 per site (material only), they are prohibitively expensive for permanent use on individual farm turnouts. Doppler meters have been used successfully for large river and ocean flow rate measurements, but are not used in irrigation districts. Vortex shedding, to the knowledge of ITRC, is a principle that has never been used in irrigation districts. However, vortex shedding is commonly used in the petro-chemical industries.

Present doppler, vortex shedding, magnetic and ultrasonic technologies sometimes guarantee an accuracy of better than 2%, whereas a ±5% accuracy would be excellent for a farm turnout. However, the 2% accuracy on large scale has been questioned. There is a need to research devices using these technologies for large-scale measurement, and to also investigate their application on smaller turnouts.

There is some evidence that magnetic and ultrasonic technology can work economically on farm turnouts - private companies in Australia have recently promoted low-cost magnetic and ultrasonic meters to replace the old "Dethridge" water wheels that used to be popular in Victoria, Australia. Together with USGS, the USBR, and a manufacturer, ITRC is presently investigating the use of some new Doppler meter technologies in a canal at the Water Delivery Facility at Cal Poly; this technology may be applicable for smaller turnouts and large canals.

This research would examine these technologies to determine how well they work and what, if any modifications could be made to reduce the cost. ITRC will meet with the various U.S. and Australian manufacturers of magnetic, vortex shedding, doppler, and ultrasonic meters to determine the suitability of their devices in their current configuration for flow measurement on both large canals, and in pipelines and small farm turnouts. The characteristics (including cost, robustness, and accuracy over a range of conditions) of various "off-the-shelf" units will first be tested both in the lab and in the field. In addition, brainstorming will be conducted with interested manufacturers to develop modified units that may reduce cost but still provide a "reasonable" accuracy.

Several manufacturers have already expressed an interest in donating equipment for the new facilities such as Floway Pumps (about **$20,000**).

D. Benefits and Costs

1. Budget Breakdown and Justification

The following is the estimated budget summary and breakdown.

Item	FY 02-03
Wages	7,500
Benefits	1000
Supplies	49,000
Equipment Rental	8,500
Total Direct Costs	66,000
Other Direct Costs*	23,100
Total Estimated Costs	$ 89,100

*Direct Cost plus 35% Modified Total Direct Costs

1. (excluding student stipends, equipment, or subcontracts over $25,000)

Salaries and overheads used in developing this cost estimate were based on existing State contracts with the California Energy Commission and the Cal Poly ITRC completed in 2000.

2. Cost Sharing

Cost Share Component:

Task 5 CEC	$200,000 (to be implemented over 3 years)
CSU/ARI	$ 57,000

	$257,000

3. Benefit Summary and Breakdown

Improvements of the ITRC training facilities is targeted towards the end-users (water district personnel and farmers) of the information, and towards individuals and organizations (such as irrigation dealerships) that have a multiplying effect. It addresses the "how to" questions that always accompany policy changes.

4. Assessment of Costs and Benefits

Training and Education project benefits cannot be quantified.

E. Outreach, Community Involvement and Acceptance

1. Outreach

The training classes will be provided to some irrigation districts that traditionally have not been able to afford for irrigation professionals to review the district operations. Some irrigation districts have been set up and operated for almost 100 years with a simple, yet flexible water supply. These districts will be the ones most impacted with tightening water supplies.

2. Training, Employment, and Capacity Building

The ITRC proposal will provide training to irrigation district personnel. It is estimated that about 400 persons receive training every year. The ITRC employs 30 persons. About 20 of these are students who are provided with an excellent opportunity to receive professional engineering training. This proposal will directly increase the base of students trained in irrigated agriculture who will contribute professionally after graduation in improving water management in California.

3. Information Dissemination

a. A summary report will be published on the Cal Poly ITRC web pages (www.itrc.org).
b. Articles will be supplied to USBR Mid-Pacific Region Water Conservation Office newsletter.
c. Articles will be supplied to Calif. DWR Water Conservation Office newsletter.